DIETARY DIVERSITY AND NUTRITIONAL ASSESSMENT IN SCHOOL GOING CHILDREN

SHORT SYNOPSIS

Submitted in partial fulfillment of the requirement of the degree of

DOCTOR OF PHILOSOPHY

to

Manav Rachna International Institute of Research and Studies
(Deemed to be University)

by

BRIJ PAL SINGH
Registration number:
MRIIRSPD1926

Under the supervision of

Supervisor
Dr. MAHAK SHARMA
Associate professor
Department of Nutrition and Dietetics
Faculty of Allied Health Sciences

Ph.D. Scholar
BRIJ PAL SINGH
MRIIRSPD1926

MANAV RACHNA
vidyantarikshat

FACULTY OF ALLIED HEALTH SCIENCES

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

SECTOR-43, SURAJKUND –DELHI ROAD, FARIDABAD – 121001

FACULTY OF ALLIED HEALTH SCIENCES

Certificate

I hereby declare that the short synopsis "DIETARY DIVERSITY AND NUTRITIONAL ASSESSMENT IN SCHOOL GOING CHILDREN" being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in Nutrition and Dietetics under faculty of Allied Health Sciences of Manav Rachna International Institute of Research & Studies, Faridabad during the academic year 2019. It is a bona fide record of original work carried out under the supervision of Dr. Mahak Sharma, Associate professor, Department of Nutrition and Dietetics, Faculty of Allied Health Sciences and has not been submitted in full or part to any other university or institute for degree or diploma. Further, it is certified that short synopsis is plagiarism free and proof has been submitted.

Signature of the Supervisor
Dr. MAHAK SHARMA
Associate professor
Department of Nutrition and Dietetics
Faculty of Allied Health Sciences

BRIJ PAL SINGH
MRIIRSPD1926

(Chairman, DRC)

Director
(Chairperson, CDP)

RECOMMENDATION

I certify that the scholar **Mr. Brij Pal Singh** Registration number- MRIIRSPD1926 PhD Nutrition and Dietetics has planned to conduct the research study entitled **"DIETARY DIVERSITY AND NUTRITIONAL ASSESSMENT IN SCHOOL GOING CHILDREN"** under my guidance and supervision. The research will be conducted in school going children in Roopnagar District of Punjab. The work progress of scholar will be regularly monitored and evaluated by me and the progress report will be submitted on every six months. I highly recommend and give good wishes to the scholar and advise to go ahead with further work.

Signature of the Supervisor

Dr. MAHEK SHARMA

Associate professor

Department of Nutrition and Dietetics

Faculty of Allied Health Sciences

ABSTRACT

Dietary Diversity is the number of food groups consumed by a person in particular time generally taken as twenty four hours before. All the eatables are divided into following food groups Carbohydrates (cereals, millets, tubers and roots), Proteins (pulses, dry fruits, meat, eggs, poultry, flesh foods, milk and products made from milk), Fats (nuts, oil seeds, fish, organ meat and liver), Vitamins(vegetables and fruits) , Minerals (condiments, spices and salt),Water and Dietary fiber. Each food group is very necessary for providing macro and micro nutrients to the body. Non consumption of any food group in the diet will lead to nutrient deficiency and that is a main reason of child malnutrition in developing countries. Dietary Diversity is measured by Dietary Diversity Score (DDS). Dietary Diversity Score (DDS) is categorized in three categories (1) LDDS (Low Dietary Diversity Score) - It is consumption of three or lesser than three groups of food out of total seven by the individual. (2) Minimum Dietary Diversity Score (MDDS) - It is defined as consumption of at least four food groups out of seven food groups. (3) ADDS (Adequate Dietary Diversity Score) - It is the consumption of more than four or more than four groups of food out of seven by the individual. My study will give Dietary Diversity status and nutritional assessment in children of school going age in our country and my research will be conducted on the school going children in the Roopnagar District of Punjab and will give the picture of Dietary Diversity among children.

Key words: Dietary Diversity, Dietary Diversity Score, Nutritional Assessment, Food Variety Score, Adequate Dietary Diversity.

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1. INTRODUCTION

The food group which a person consume in a particular reference time period which is more probably twenty four hours is called Dietary Diversity (Joanne E. Arsenault, Elizabeth A. Yakes, M. Munirul Islam, Mohammad B. Hossain, Tahmeed Ahmed, Christine Hotz, Bess Lewis, Ahmed Shafiqur Rahman, Kazi M. Jamil and Kenneth H. Brown. 2013.)

All nutrient rich foods are important elements for every individual. There are six main nutrients which are required for adequate nourishment that is necessary for the growth, development and to lead active and healthy life. The main nutrients are Carbohydrates, Proteins, Fats, Minerals, Vitamins and Water. These nutrients are obtained from different food groups. All the eatables are divided into seven food groups Carbohydrates (cereals, millets, tubers and roots), Proteins (pulses, meat, eggs, poultry, flesh foods, milk and products made from milk), Fats (nuts, oil seeds, liver, organ meat and fish), Vitamins (vegetables and fruits), Minerals (condiments, spices and salt), Water and Dietary fiber (Gopalan C, RamaSastri B.V, Balasubramanian S.C, NarsingaRao B.S, Deosthale Y.G , Pant K.C.2006).

DDS (Dietary Diversity Score) is the scale to assess the Dietary Diversity. All eatable items which are part of our food are provided by consuming the items from one of these food groups. Non consumption of food items from these groups and variety of items from within the groups leads to deficiency of any macro or micro nutrient which leads to nutritional deficiency and morbidity. IDDS (Individual Dietary Diversity Score) is tool to assess adequacy of diet. DDS (Dietary Diversity Score) is the consumption of different food groups by a person in twenty four hours (FAO.2013).

FVS (Food Variety Score) is the food items taken from different food groups. Food Variety is also indicator of nutrient adequacy for an individual (Hatløy A, Torheim LE, Oshaug A.1998).

Nutrition adequacy was directly linked to the food groups and food items consumed by an individual (Torheim LE, Ouattara F, Diarra MM, Thiam FD, Barikmo I, Hatløy A, A Oshaug.2004).

Various researches shows Food Variety affect the nutritional status of the children whether under nutrition or over nutrition (Saibul N, Shariff ZM, Lin KG, Kandiah M, Ghani NA, Rahman HA. 2009).

It is not only food which is given to the child is sufficient to fulfill the requirement of the body. Inadequate diet is often given to the children and it does not fulfill the nutritional needs on the basis of food variety and Dietary Diversity (Pan American Health Organization. 2003).

A study on children on Caribbean showed anemia (Food and Agriculture Organization (FAO) of the United Nation. 2007).

Dietary Diversity is classified into two groups that are Household Dietary Diversity (HDD) and Individual Dietary Diversity (IDD). The number of Food groups taken by an individual in previous day at home is known as HDD (Household Dietary Diversity) and this excludes food purchased and eaten outside the home and is related to socio economic level of household. IDD (Individual Dietary Diversity) is the food groups given to a person in particular reference of time generally taken as last twenty four hours whether from home or outside of the home and it gives the idea about nutritional quality of individual's diet. It includes WDD (Women's Dietary Diversity) and CDD (Composite Dietary Diversity).

WDD (Women's Dietary Diversity) gives account of adequacy of micronutrient of the diet. Composite Dietary Diversity (CDD) is given by sum of food groups reported by mother for each child from total food groups in a given reference of time that is in last 24 hours (FAO.2013).

In the developing countries main nutrition problem in children is the low Dietary Diversity commonly lack of Proteins ,vitamins and minerals specially vegetables and fruits but it has been shown that amount of carbohydrates and fats increased during 1970 to 2002 (FAO.2006).

Many researches shows that Dietary Diversity is one of the main cause of child malnutrition and this doubles the burden of malnutrition, cardiovascular risk, dyslipidemia and higher metabolic syndromes (Labadarios D, McHiza ZJ, Steyn NP, Gericke G, Maunder EM, DavidsYD . 2011, DeleuzeNtandouBouzitou G, Fayomi B, DelisleH. 2005, Truthmann J, Richter A, Thiele S, Drescher L, Roosen J, Mensink GB. 2012, Li Y, Wedick N, Lai J, He Y, Hu X, Liu A .2011).

Another study in Ethiopia showed that lacking of animal source food resulting in the inadequate nutrients for growth like vitamin A, vitamin B, calcium, zinc, iron, potassium and magnesium (Herrador Z, Sordo L, Gadisa E, Buño A, Gómez-Rioja R, Iturzaeta JM . 2014, Lanou AJ, Berkow SE, Barnard ND. 2005).

Dietary Diversity can be measured by taking household data of food assess and intake of diet by an individual which is a very difficult and typical task. For this purpose a questionnaire is a very user friendly and low cost tool which can be used to measure the Dietary Diversity in a limited time period. The quality measure of food consumption is reflected by the data collected through questionnaire is converted into Dietary Diversity Score (FAO.2013).

A total food group taken in diet reference period gives nutritional adequacy (Habte TY, Krawinkel M .2016).

Education Scenario

The health is the fundamental importance of youth and children. About 1/5th of children's population falls in 5-14 years of age of the primary and secondary schools. There are three kinds of schools in Punjab i.e. Government, Government Aided and Private Schools.

The Children from lower Socio Economic background are studying in Government and Government Aided schools which are affiliated with State Board i.e. Punjab School Education Board in Punjab where medium of instruction is mostly Punjabi, While the children from rich families are studying in Private Schools, where medium of instruction is English. These schools are affiliated with CBSE or ICSE Board. In Government and Government Aided Schools, Government has launched Mid day Meal Scheme in which free lunch is provided to the students of Primary (1^{st} to 5^{th} Class) and upper Primary classes (6^{th} to 8^{th} Class). In addition to this to control anaemia Iron Folic Acid supplementation and to control worm infection Albendazole tablets also given by the Government. Various studies showed poor nutrition status, deficiencies and poor health in school going children. This causes low enrolment, early dropout, absenteeism and poor performance in studies. Today's children will be tomorrow's citizen for a nation. Their care must be taken to secure the future of a strong nation and even for the whole world. Without that development cannot be possible and all the other efforts will prove to be a failure.

Nutritional Status and Nutritional Assessment

Nutritional Status is defined as the intake and utilisation of nutrients by an individual. The strategy to determine the extent and severity of nutrition problems is called nutrition assessment.

Nutrition assessment can be done by two methods

1. Direct assessment
2. Indirect assessment

Common Methods of Direct assessments are:

1. Nutritional Anthropometry
2. Clinical Examination
3. Bio Chemical Estimation
4. Dietary Assessment.

The main objective of Nutritional assessment in a community is to measure the malnutrition's magnitude and distribution in a geographical area. This helps to apply the Government plans and schemes effectively in the community. The other purpose of nutritional assessment is to discover health problems, analyse ecological factors and to advise proper and corrective measures which can be properly applied and easy for community participation (Hasan I, Zulkifle M, Ansari AH.2011).

2. Literature Review

NP Steyn, JH Nel, G Nantel, G Kennedy , D Labadarios (2006) assessed whether FVS (Food Variety Score) and DDS (Dietary Diversity Score) can give the adequacy of macro and micro nutrients in the diet taken by South African children. The data of nationally represented 1-8 years old 2200 children was analyzed and Dietary diversity score, food variety score, mean adequacy ratio calculated. Pearson correlation coefficient was calculated. The results showed mean adequacy ratio and FVS (Food variety score) and DDS (Dietary Diversity Score) was highly correlated. It indicates that FVS (Food Variety Score) and DDS (dietary diversity score) can be used for the measurement of adequacy of micro and macro nutrient and to measure the growth of children.

Ekesa BN, Blomme G and H Garming (2011) in their cross sectional study to establish the relation between DDS (Dietary Diversity Score) and preschools children nutritional status. The sampling was done by systematic random sampling. Dietary diversity was assessed by taking 24 hr recall period. Anthropometric measurements were taken for nutritional status. It was found that only 7% children of Butembo and 29% of Gitega consumed diversified diet. Stunting was most prevalent that is 63.57% and 78.6% from Gitega and Butembo respectively and 20% and 3.25% of children were found wasted in Gitega and Butembo respectively. The study clearly showed significant level of malnutrition and low DDS (dietary diversity score) in Butembo and Gitega.

Sahar Hooshmand and Shobha A Udipi. (2013) investigated the relationship between nutritional status and dietary diversity in urban primary school children from India and Iran. The study was conducted on 4570 children from primary schools of Mumbai, India and Ahwaz, Iran. 6 to 9 years old children from low and middle income group population was selected for the study. Dietary diversity score was calculated by categorizing eleven food groups. Study showed that students with adequate DDS (Dietary Diversity Score) were having better nutritional status than the students with low dietary diversity score.

Joanne E Arsenault, Elizabeth A Yakes, M Munirul Islam, Mohammad B Hossain, Tahmeed Ahmed, Christine Hotz, Bess Lewis, Ahmed Shafiqur Rahman, Kazi M. Jamil and Kenneth H. Brown (2013) in their cross sectional study assesses the quantity of micronutrient intake in young children and their mothers. 480 children of age group of two years to four years and women in 2 sub districts of northern Bangladesh were taken. 24 hour dietary intakes were noted. The micronutrient intake adequacy was compared to DDS (dietary diversity score). The analysis which applied was correlation and multivariate regression. Results showed that 26% women and 43% children had inadequate micronutrient consumption. Results clearly explained that there was inadequacy of micronutrient in women and children in the rural areas of Bangladesh as well as their food consumption was deficient in energy and very low diversified.

Sealey Potts C and Potts AC (2014) did a cross sectional study on 423 children from different pre schools and investigated food variety and dietary diversity with nutritional status. Data collection was done by 24 hrs recall procedure by structured questionnaire. The children which met minimum dietary diversity were 48% and this study showed there was a significant and positive correlation between DDS (dietary diversity score) and FVS (food variety score).

Dickson Abanimi Amugsi, Maurice B Mittelmark and Abraham Rexford Oduro (2015) studied relation of dietary diversity of child and mother's dietary diversity in the Ghana population. Data for the study was taken from Demographic and health survey 2008 which were from 1187 pairs of mother and their child. DDS (Dietary diversity score) was calculated using twenty four hours recall. Linear regression was used and the results showed positive association between child and mother dietary diversity score. Study also showed that older age child and with greater women's empowerment was associated with higher child dietary diversity score.

Trias Mahmudiono, Sri Sumarmi and Richard R Rosenkranz (2017) in east java Indonesia conducted a cross sectional study on 768 household children of less than 5 years age assessed the association between dietary diversity and stunting. Logistic regression models were used. 24 hrs maternal recall food data was taken for twelve food groups. Results showed that 39.4% of the children were stunted. Mean household dietary diversity score was moderate that is 9.1. This study gave protective relationship between child stunting and dietary diversity.

Mahama saaka, Shaibu Mohammed Osman and Irmgard Hoeschle-Zeledon (2017) in their cross-sectional survey investigated relationship between agriculture biodiversity and dietary diversity. The study population was 1200 mother child pairs and the sampling method was two stage cluster sampling. 24 hrs time period was taken. Regression analysis was used. Results showed that four food groups out of seven were consumed by 42.4% household. Spearman correlation analysis was used to compare agriculture diversity and CDD (child dietary diversity). Study showed positive association between agriculture diversity and CDD (child dietary diversity) in families of rural household having low socioeconomic status as compared to families of high socioeconomic status. This showed agriculture diversity is the one of the methods for giving diverse diet in lower socioeconomic status families of rural areas.

D J nithya and RV bhavani (2017) conducted a study about dietary diversity and nutritional status among adults and adolescents in Vardha district in Maharashtra and Koraput district in Orissa to find the relationship between them. 24 hrs recall system was used for household dietary diversity. Food items were grouped into 13 categories as given by ICMR (2012). Anthropometric measurements were used for nutritional status assessment. Results showed that 51% of boys and 27% of girls were wasted and stunted. 48% of women and 36% of men were found undernourished that is women were more malnourished than their counterparts men. Berry's index was used to calculate mean dietary diversity and was found 90 in both adult male and female and 89 in boys and 90 in girls of adolescent age. Overall DDS (dietary diversity score) was low. A positive correlation was shown between intake of nutrients and dietary diversity in this study.

S. Chandrasekhar, Víctor M Aguayo, Vandana Krishna and Rajlakshmi Nair (2017) had analyzed 2012 nutritional survey which was conducted in Maharashtra on 2630 households for assessment of mother's nutritional status and children's nutritional status. Aim of the research was to address three main issues that is dietary diversity in children, prediction of lower risk of under nutrition and households with secure food improved dietary diversity in children. The children from moderately and severely food insecure household were found lower dietary diversity score and such children were highly stunted, underweight and wasted. After controlling children's dietary diversity it was found that there was no association of under nutrition (stunting, wasting and underweight) with food security but it was associated statistically with dietary diversity.

Kakoli Borkotoky, Sayeed Unisa and Ashish Kumar Gupta (2017) assessed the Dietary Diversity and different other measures of nutritional status of Indian children. Consumer expenditure survey (1993-2012) and National Sample Survey Organization and National Family Health Survey (2005-2006) were used. Study found that dietary diversity is significantly associated with children's nutritional status. Regular income of households and education level of mothers were found important factors for children's nutritional status improvement.

Ukegbu Patricia Ogechi and Ogu Victoria Chilezie (2017) in their cross sectional survey studied DDS (dietary diversity score) of children below five years age from rural communities in Imo state, Nigeria and its relationship with nutritional status. 226 mothers and under five children selected randomly and 24 hrs recall with pretested questionnaire was used. Z score was used. Linear regression and chi square analysis were applied and showed DDS (dietary diversity score) 73.5% (low), 25.2% (moderate) and 1.3% (high). The study clearly showed that dietary diversity score was significantly associated with total family income.

Raymond Boadi Frempong and Samuel Kobina Annim (2017) in their cross sectional survey investigated effects of infant feeding practices to the child health and its determinants. Data collection was from multiple indicator cluster survey fourth round in 2011 of Ghana. Regression analysis was used on 6598 children. The analysis clearly showed that health of children in Ghana can be improved by taking diversified diet.

Rebecca C. Robert, Hilary M. Creed-Kanashiro, Mary E. Penny, Margot Marin, Bethann Cottrell (2017) in three countries Peru, Bangladesh and Sierra Leone examined CDD (Child Dietary Diversity) and HDD (Household Dietary Diversity). It was found that there is a correlation between them. The study was conducted on poors in rural areas. Data collection was done from randomly sampled households. 24 hrs dietary recalls of child's intake was taken. Bivariate analysis, generalized linear modeling was used. It was found that 53% children in Sierra Leone, 61% children in Bangladesh and 89% of children in Peru met minimum dietary diversity. The results conclude that 6-8 months infants were having minimum dietary diversity as compared to 9-11 months and 12-23 months old children and thus 6-8 months children having more risk for not meeting minimum dietary diversity. Study also suggests that the availability of food groups in household and food selection by parents especially mothers may limit dietary diversity.

Nivo Heritiana Rakotonirainy, Valérie Razafindratovo, Chitale Rabaoarisoa Remonja, Randza Rasoloarijaona, Patrice Piola, Charlotte Raharintsoa, Rindra Vatosoa Randremanana (2018) investigated in their study Dietary habits of children. The study was conducted in rural areas of Moramanga and Morondava, Madagascar. The main purpose of the study was to identify the determinants of inadequate Dietary Diversity in children. Data collection on 1824 children aged 4-59 months using 24 hrs recall method was done. Bivariate and multivariate analysis was applied to find out reasons for children’s low DDS (dietary diversity score). In Moramanga 42.1% children and in Moramanga 47.6% children were found to have poorly diversified diet. The study shows poor maternal education, low socioeconomic status household and household without livestock associated with non varied diet and low dietary diversity score in both areas.

Istiyaq Ahmad, Najam Khalique, Salman Khalil, Urfi and Mohd Maroof (2018) in their cross sectional survey find out prevalence of stunting in 6 to 23 months old children and its association with dietary diversity. Simple random sampling technique was used for sample size. Total 326 children were included in the study and pretested questionnaire was used. Prevalence of stunting was found to be 45.7% and this was significantly associated with dietary diversity.

Sutapa Agrawal, Rockli Kim, Jewel Gausman, Smriti Sharma, Rajan Sankar, William Joe and S. V. Subramanian (2019) had analyzed the data from the National Family Health Survey (NFHS 4) 2016 of the age group of 6 to 23 months of children. Mother's twenty four hour recall method was used. Dietary diversity of children was assessed with respect to socioeconomic status, education of mother, consumption of food and adequately dietary diversity intake. The result showed that only 23% of children were having ADD (Adequate Dietary Diversity). MDDS (Mean Dietary Diversity Score) was 2.26. Both socioeconomic status of family and education of mothers and caregiver was found strongly associated with dietary diversity.

Jieying Bi, Chengfang Liu, Shaoping Li, Zhenya He, Kevin Chen, RenfuLuo, Zimeiyi Wang, Yanying Yu, Haiquan Xu (2019) conducted a cross sectional in preschoolers in poor, rural and ethnic minority areas of Central South China. 1328 preschool children of age three or five years selected and DDS (dietary diversity score) was calculated by taking twenty four hours recall method. MDDS (mean dietary diversity score) was 5.77. The study proved that DDS (dietary diversity score) of children was positively associated with education level and nutritional knowledge of primary caregiver, preschool kitchen manager and school teachers.

Tsedeke Wolde and Tefera Belachew (2019) in their cross sectional study on school aged children in Southern Ethiopia investigated the association between nutritional status and dietary diversity. Study was conducted on 408 school aged children. Data collection was done using structured interview questionnaires and anthropometrics. 24 hrs recall method was used for data collection. The prevalence of thinness was found to be 10.1%. The study also showed that rural areas children were 65% more likely to be thin than the children from urban areas. 27.5% children from rural areas were found with Minimum Dietary Diversity (MDD). It was concluded that dietary diversity and thinness was significantly associated.

Estefania Custodio, Zaida Herrador, Tharcisse Nkunzimana, DorotaWęziak-Białowolska, Ana Perez-Hoyos and Francois Kayitakire (2019) had done multilevel analysis of dietary diversity and its associated factors in children. The data was obtained of rural areas children of 6 to 23 months from the demographic health survey of 2010 of Burundi and Rwanda. Minimum dietary diversity score was calculated. Two level logit regressions was used. In rural areas of Rwanda 23% children and rural areas of Burundi 16% children were found with minimum dietary diversity. The analysis also showed increasing age, living standards, mother, father and caregiver education level were associated with minimum dietary diversity in both countries.

3. Description of Topic

Dietary diversity in school going children is the measurement of number of food groups taken by children of school going age. All people need a variety of the foods to meet requirement of essential micro and macro nutrients. Every food item provides a particular type of nutrient to our body. Lack of any type of food item leads to deficiency of particular type of nutrient and affects nutritional status of children and causes malnutrition which leads to various types of morbidity. To monitor the nutritional status of children periodic nutritional assessment is necessary. Lack of dietary diversity in developing countries like India is a severe problem in low economic populations. Many children of our country are undernourished due to non availability of required diverse diet. So it is very necessary to measure required amount of food. It can be done by measuring dietary diversity and nutritional assessment in school going children.

4. Objectives of Research

1. To assess the Dietary Diversity of school going children in the seven to twelve (7-12) years of age.
2. To assess the nutritional status of school going children in the seven to twelve (7-12) years of age.
3. To correlate between the Dietary Diversity and nutritional status of school going children in the seven to twelve (7-12) years of age.

Importance of Research-

The school age is the active growing phase of childhood. Body requires many nutrients during growth in adolescents and these nutrients should be stored in the body during childhood. If not stored properly this can prove hazardous in future life and leading to many health consequences such as retardation in growth, malnutrition, reduced working capacity, poor mental and social development and low academic performance. This research will help to know the nutritional knowledge of the family especially mothers of the selected children to know the nutritive requirement of their children during their different stages of life. This can be done for planning a nutritional educational programme for children. As poor food choices is a main factor responsible for development of malnutrition.

5. Methodology

- **Locale – Roopnagar**

The study will be conducted in the District Roopnagar of Punjab. Roopnagar district is divided into four development blocks (1) Roopnagar (2) Anandpur Sahib (3) Nangal (4) Chamkaur Sahib. It is situated at the distance of fifty kilometers from Chandigarh. It is famous for Archaeological Museum having remains from Harappan civilization. The remains from Indus valley civilization were placed in this museum. Roopnagar district is also famous for Bhakra dam which is on Satluj river at Nangal.

- **Study design**

The present study will be a cross sectional study among children of Primary and Upper Primary (seven to twelve years old). The information will be collected from the children, parents and teachers. Children's anthropometric measurements will be taken.

- **Study population:**

Seven to twelve (7-12) years old school going children.

- **Sample size**

Prevalence of Dietary Diversity is 39.3% at confidence level 95% and 0.05 significance level. Thus sample size calculated as per formula is 370.

- **Sampling Procedure**

Sampling procedure will be cluster sampling. Roopnagar district will be divided into four clusters according to four development blocks that is Roopnagar, Anandpur Sahib, Nangal and Chamkaur Sahib. Equal number of participants from the schools of each block will be selected for data collection. Number of girls and boys will be in equal numbers from each block in both the age group.

- **Inclusion and Exclusion criteria**

1. Seven to twelve (7-12) years old school going children of Rural as well as Urban areas.
2. All children who will be willing to participate in the study.
3. It will be ensured that girls and boys will get equal representation.
4. Mandatory consent will be taken.
5. The children having morbidity, disability and any other type of serious illness will not be included in the study.

- **Data collection**

The methods used for data collection will be:

1. Anthropometric assessment of the children.
2. Dietary assessment.

- **Study tools**

1. **Anthropometric measurements** will be taken to assess the nutritional status of the participants.

   The heights of the students will be measured in cm using a standardized height measuring rod. This instrument will be highly reliable with measurement sensitivity of 0.1 centimeter for height in an upright position with barefoot.

   The weight of the students will be measured in kg using a standardized weighing scale. This instrument will also be highly reliable with a measurement sensitivity of 100 grams for weight. Heavy clothes like coat and other accessories will be removed before taking the weight measurement.

   Measurements will be taken following the WHO guidelines. The weight and height will be measured next to each other to save time and to make children comfortable. All the measurements will be taken before meals.

2. **Standardized pretested food frequency questionnaire** will be used for Dietary Diversity assessment of last 24 hours.The participants/parents/teachers will be asked in a friendly way to recall about children's diet of the previous day. They will be shown samples of different sized plates, katoris and glasses and will be asked to choose the approximate size of the utensil in which they use to estimate the quantity of the food items eaten and the data collected will be filled in pre tested questionnaire.

- **Ethical Considerations**

Before the survey will be conducted,

- Written Permission will be taken from concerned higher authorities.
- Written consent will be taken from the students and parents for this study and also for the video recording during data collection.
- The subjects will be explained the nature and the purpose of the study.
- The subjects will be explained that there will be no direct benefits for the children who will participate in the study.
- There will be no risks or harm involved at any stage of the study.
- No sensitive questions will be asked from the children.
- The participation in the study will be voluntary; no coercion will be there at any stage of decision making.

- **Statistical Considerations**

Focusing on the objectives of the study, the collected data will be coded, tabulated and analyzed.

3. Proposed/expected outcome of the Research

The proposed study is being planned to know about

1. The Dietary Diversity of school going children.
2. Whether all the required nutrients (macro and micro) are being taken by the children.
3. Children's nutritional status whether normal, stunted, wasted, underweight or overweight.
4. Whether nutritional status is associated with the Dietary Diversity.

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